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Canadian Science Advisory Secretariat
Maritimes Region **Science Response 2021/028**

STOCK STATUS UPDATE OF LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREA 35 FOR 2020

Context

The scientific basis for assessing the status of American Lobster (*Homarus americanus*) in Lobster Fishing Area (LFA) 35 was examined at a framework meeting in September 2019, followed by an assessment of the status of the Lobster resources in LFA 35 in October 2019 (DFO 2020). The assessment identified one primary indicator and three secondary indicators that describe changes in Lobster abundance and biomass, as well as proposed reference points for the primary indicator. This update applies a suite of indicators from the 2019 framework to the stock status up to the end of the 2019–2020 fishing season wherever possible.

This Science Response Report results from the Regional Science Response Process of August 20, 2020, on the Stock Status Update of American Lobster in Lobster Fishing Area (LFA) 35.

Background

Description of the fishery

Commercial Lobster fishing in LFA 35 occurs in the Bay of Fundy (Figure 1) and borders the biggest Lobster fishery in the Canadian Northwest Atlantic, LFA 34, that has the highest landings and the most participants of any LFA in Canada. Landings in LFA 35 began a long-term increase in the mid-1990s, and current landings are near a record high. A similar increase in landings was also observed in most of the Gulf of Maine regions and other LFAs in Atlantic Canada.

The fishery is managed by input controls including a Minimum Legal Size (MLS, 82.5 mm Carapace Length [CL]), prohibition on landing of both egg-bearing and V-notched females (with no setal hairs), limited entry, split fishing season (October 14th–December 31st; last day of February–July 31st), and trap limits (300). Other management measures include the requirement of vents to allow sub-legal-size Lobster to escape and biodegradable trap mechanisms to mitigate ghost fishing by lost traps.

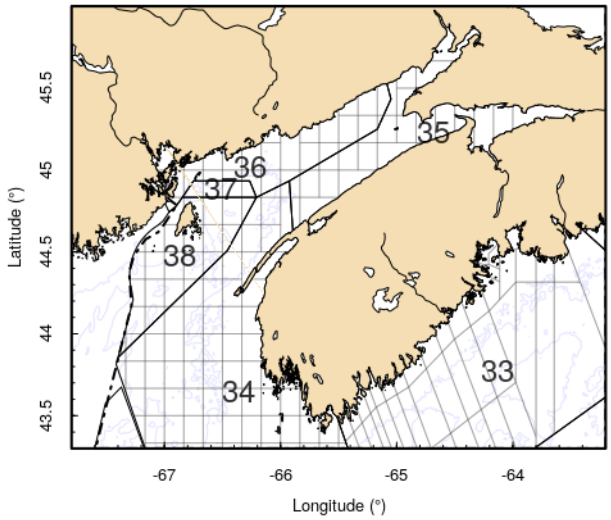

Figure 1 Map of Lobster Fishing Area (LFA) 35 with logbook reporting grids outlined in grey.

Analysis and Response

Indicators of Stock Status

The stock status of the Lobster in LFA 35 is assessed using primary, secondary, and contextual indicators. This update will include the primary indicator that is used to define stock status in relation to reference points defined in Cook et al. (In prep.[1]) and secondary indicators that display time-series trends but do not have reference points. The data sources available for establishing indicators for LFA 35 come from both fishery-dependent and fishery-independent data sources. Fishery-dependent data consist of commercial logbooks that report information on date, location (grid), effort, and estimated catch. The fishery-independent data sources are from the DFO Maritimes Region Summer Trawl Survey (herein RV survey).

Primary Indicator

In LFA 35, there is one primary indicator for stock status that describes the time-series trends relative to reference points. The primary indicator for describing stock status is standardized commercial Catch Per Unit Effort (CPUE). There is currently no primary indicator of fishing pressure or exploitation.

Catch Per Unit Effort

Commercial catch rates are a preferred indicator over landings data, as they are standardized to account for the level of fishing effort. This is especially important in effort-controlled fisheries. The commercial fishing data used in the estimation of catch rates were obtained from mandatory logbooks that were put in place in the mid-2000s. It has been well documented that trap-based catch rates will vary throughout a fishing season due to factors other than available biomass. These factors include fishing behavior, localized depletion, and environmental conditions (Drinkwater et al. 2006). In an effort to account for these factors, CPUE data were standardized through generalized linear modelling with explanatory variables of Year, Day of

[1] Cook, A.M., Hubley B., Howse V., and Denton C. (In prep). 2019 Framework Assessment of the American Lobster (*Homarus americanus*) in LFA 34–38. DFO Can. Sci. Advis. Sec. Res. Doc. Presented and reviewed in January 2019 at the Framework Assessment meeting.

Season, Temperature, and the interaction between Day of Season and Temperature. Year effects were treated as factors rather than a continuous variable to reduce any constraints from inter-annual variability.

Model predictions were made for day 1 of the fishing season at the median day 1 temperature across all years. The available time series covers the current high-productivity period and a lower-productivity period from 2006–2010. The median of the high-productivity period (2011–2018) was used as the proxy for the biomass at carrying capacity (K). Following the recommendations of DFO (2009), the Upper Stock Reference (USR) and Limit Reference Point (LRP) were set to 40% and 20% of the K proxy. The 3-year running median is used to compare the standardized CPUE to the USR and LRP. This value will dampen the impact of any anomalous years that may occur due to factors outside of changes in abundance.

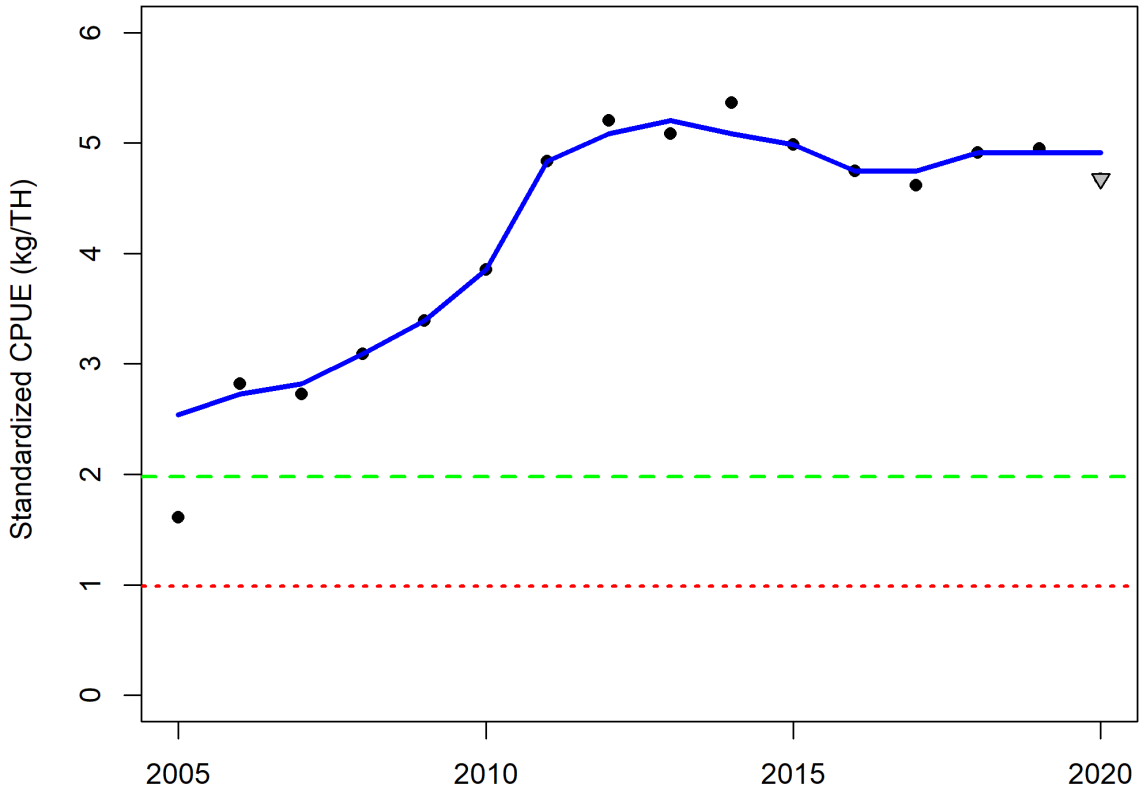

Figure 2. Time series of standardized commercial catch rates (kg/trap haul; black dots) for LFA 35, along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). The data for 2019–2020 fishing season are incomplete (grey triangle).

The trend in CPUE indicates that an increase in stock biomass occurred between 2005 and 2012 (Figure 2). The CPUE has remained high (more than twice the USR) since 2011. The 3-year running median for CPUE for the 2020 season is 4.91 kg per Trap Haul (kg/TH), which is above the USR (1.98 kg/TH) and LRP (0.99 kg/TH). The CPUE for 2020 is preliminary due to outstanding logs; the monthly reporting rate is currently between 23% to 48% by month.

Secondary Indicators

Secondary indicators represent time-series trends that are tracked individually, without defined reference points. The secondary indicators for LFA 35 include the LFA-specific landings and total effort, as well as recruit abundance, commercial biomass, and relative fishing mortality estimates from the RV survey of the Bay of Fundy region (strata 484, 490–495). Scallop survey recruit abundance is not included in this update because the survey was not conducted in 2020.

Landings and Effort

Commercial landings are related to population biomass, as fishery controls are input- (effort controls) rather than output-based (total allowable catch). There are many factors that can affect this relationship, including changes in levels of fishing effort, catchability (including the effects of environment, gear efficiency), Lobster size distribution, and the spatial overlap between distribution of Lobster and effort.

Fishing effort, recorded as the number of Trap Hauls (THs), in the Lobster fishery is controlled by fishing season length, trap limits, and limited number of fishing licences. Consequently, there is a maximum fishing effort that can be deployed; however, this maximum is never met because factors such as weather conditions, seasonally variable catch rates, and fishing partnerships limit the total number of THs. Total fishing effort is calculated from mandatory logbooks.

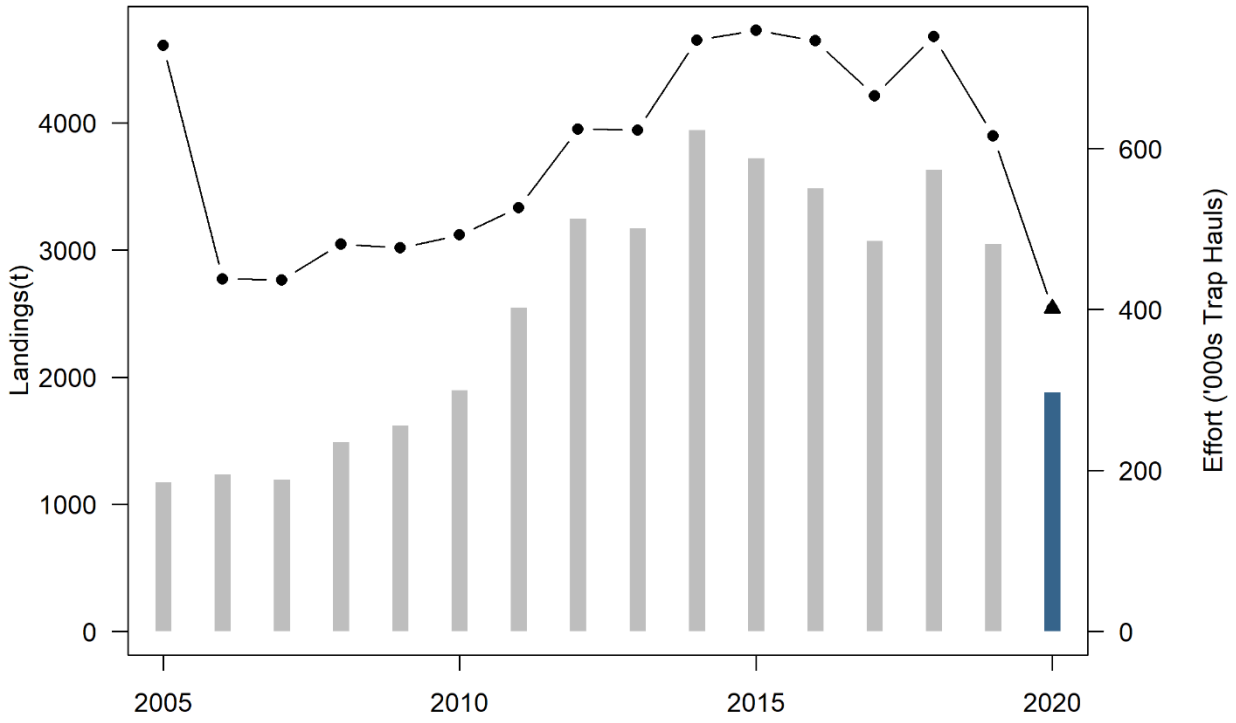

Figure 3. Time series of landings (grey bars) and effort (black line with points) for LFA 35. The data for 2019–2020 fishing season are incomplete due to outstanding logs (blue bar for landings, black triangle for effort).

The historical landings in LFA 35 between 1947 and 1984 had a median of 134 t with a range of 75–184 t, increasing slightly between 1984 and 1994 to a median of 250.5 t (range 226–330 t). In the more recent years, LFA 35 landings have increased substantially. The landings for the

2019–2020 season are 1,878 t. This does not represent the total for the season due to outstanding logs.

DFO RV Survey Commercial Biomass and Recruit Abundance

Despite strata boundaries having significant overlap with LFA 35–38, there were few (< 20 per year) sets within each LFA, suggesting that the value of indicators derived from these data was limited. Extending the commercial survey biomass index to years prior to 1999, when size information was not collected, was performed using the ratio of commercial to total biomass estimated between 1999 and 2018 (0.746). The time series of commercial biomass showed a pulsed increase from 2000 to 2004, with a variable, but increasing, trend from 2010 to 2018; however, survey catch rates in the last two years were the lowest in the last 10 years (Figure 4). The size at maturity for the Bay of Fundy is substantially greater than the MLS, and, as such, the commercial biomass available post-fishery will constitute those individuals entering the spawning population in the upcoming year.

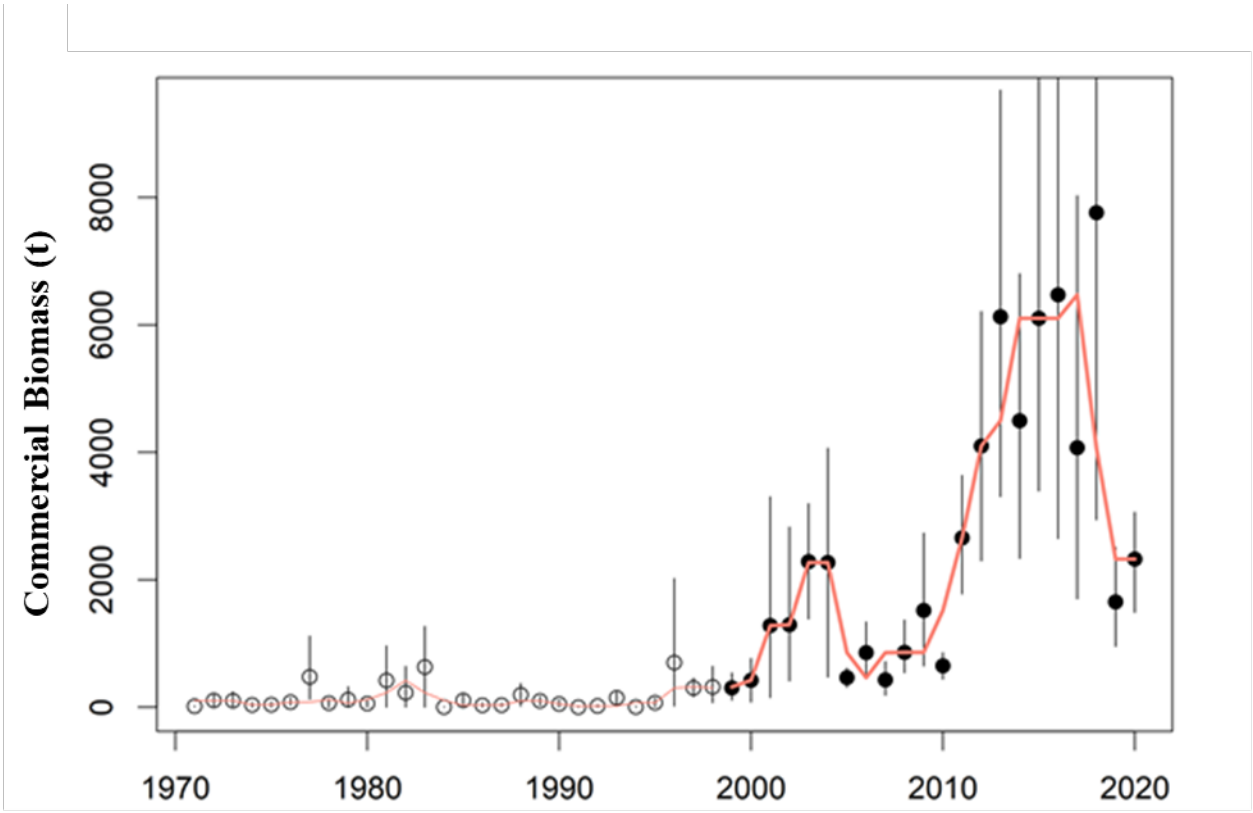

Figure 4. Time series of Research Vessel Survey trends for LFA 35–38 commercial biomass. Values prior to 1999 were derived using the mean proportion of commercial to total biomass between 1999 and 2018 (0.746). Error bars are 95% bootstrapping confidence intervals.

RV survey recruit abundance (70–82 mm CL) exhibits a similar pattern to the total abundance, with increases from 2010 to 2013, followed by variable catch rates at a substantially higher level than has been observed in the time series (Figure 5).

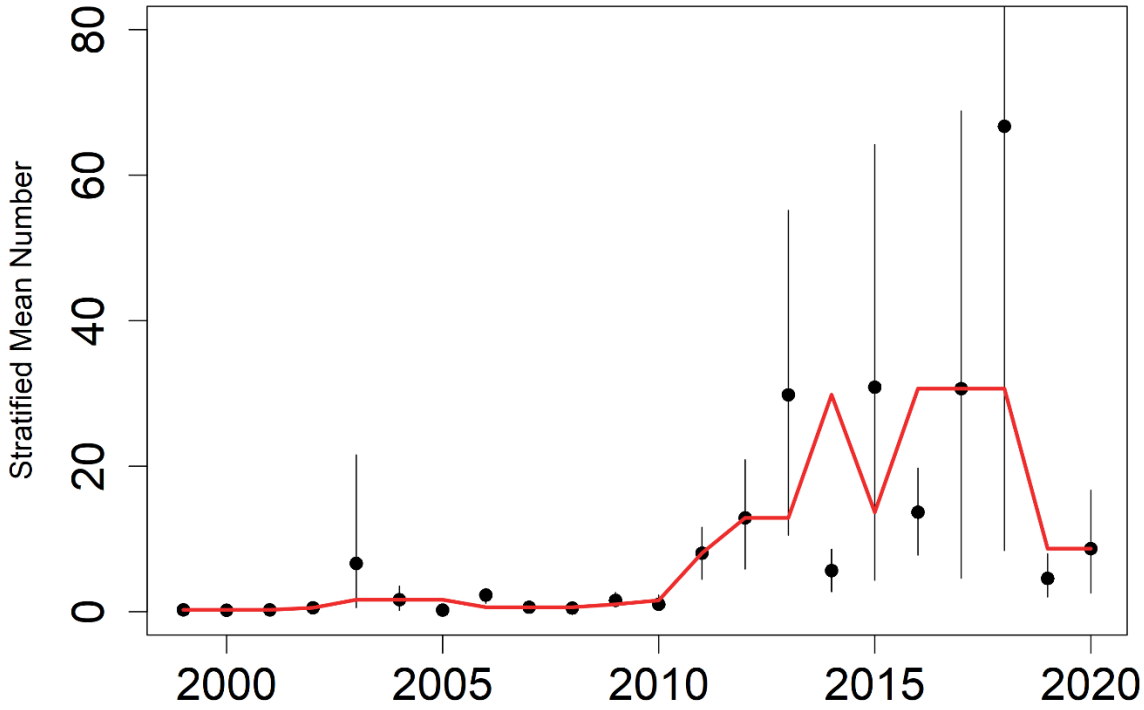

Figure 5. Time series of DFO Research Vessel Survey trends for LFA 35–38 recruit abundance. Red line represents the 3-year running median. Error bars are 95% bootstrapping confidence intervals.

Relative Fishing Mortality

Relative fishing mortality (*relF*) uses both the RV survey commercial biomass estimates and landings to show the changes in removals (C_t) relative to the survey indices (I_t). As the RV survey occurs after the fishery is complete, the estimation of *relF* was adjusted by the landings as:

$$relF_t = \frac{C_t}{(I_t + C_t)}$$

Assuming that survey catchabilities were constant and the index of commercial biomass was proportional to true commercial biomass, *relF* represented an index of fishing mortality (*F)*.

The estimates of *relF* reflect the variation in the commercial biomass index, with decreases between the late 1990s and early 2000s, increases to 2010, then decreases to 2013 with variable, but low, estimates of *relF* since (Figure 6). Tracking the *relF* for the Bay of Fundy provides a depiction of the patterns observed across the larger area.

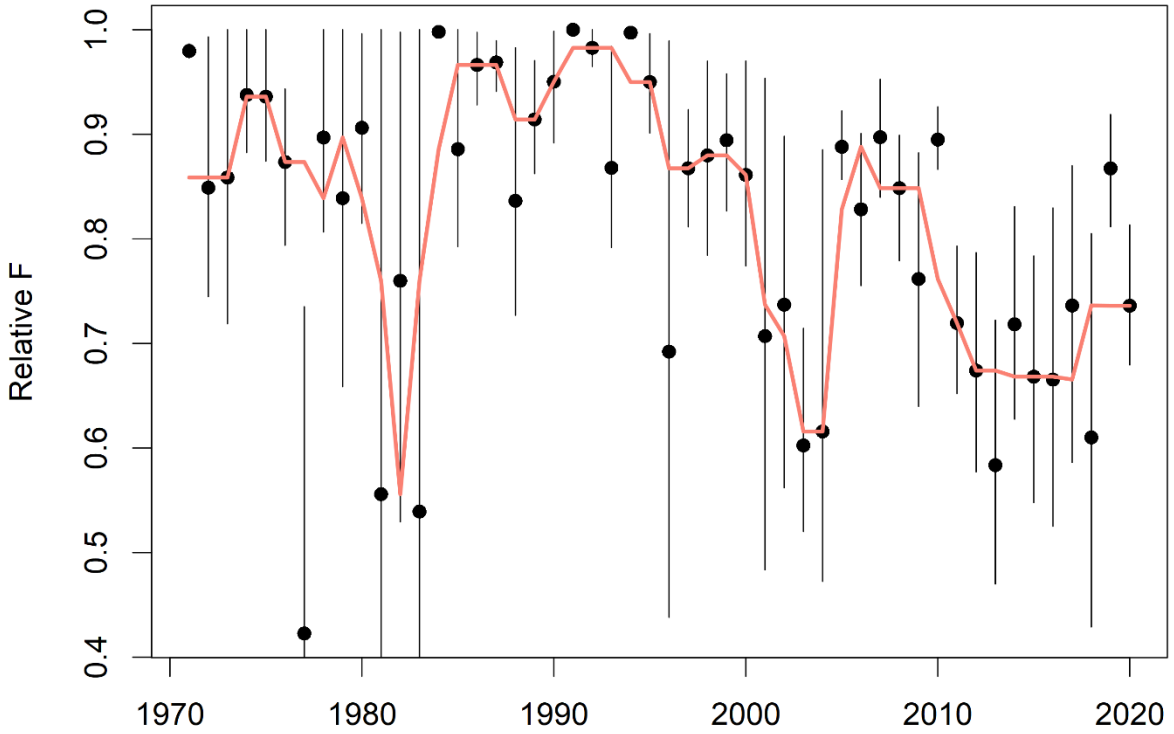

Figure 6. Relative fishing mortality (F) from the Research Vessel Survey commercial biomass estimates and the landings in LFA 35–38. Error bars are 95% bootstrapping confidence intervals.

Conclusions

The primary indicator of stock status, CPUE, shows a positive signal for LFA 35 and remains well above the USR. Commercial biomass from the survey is the lowest in the last 10 years, but it is still above the long-term median. Continued monitoring of fisheries-independent data sources is a high priority for Science monitoring. Since 2011, LFA 35 has been in a high-productivity period. The LFA 35 Lobster stock is currently in the Healthy Zone. Given the monthly reporting rate is currently between 23% and 48%, landings appear to be on track with recent years. There has also been an increase in total, commercial, and recruit abundance since the early 2000s, particularly since 2010.

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Sources of Information

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